Research on the Reform and Innovation of Mathematics Course Teaching Based on the OBE Concept in the Context of AIGC

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Abstract. Application-oriented undergraduate programs aim to cultivate high-quality technical and skilled applied talents, with mathematics as a core public foundational course serving as a key tool for professional learning and solving practical engineering problems. Based on AIGC technology and the OBE outcome-based education concept, this paper focuses on the pain points of mathematics teaching in application-oriented undergraduate programs, explores the reform paths of blended online and offline teaching, sorts out strategies for the integration of mathematics and majors, and summarizes practical results, aiming to build an intelligent and practical mathematics teaching system adapted to student learning conditions.

Keywords: AIGC, OBE, Application-Oriented Undergraduate Education, Teaching Reform.

1 Introduction

Traditional mathematics teaching cannot meet the learning needs of students at different levels, and students' abilities to apply mathematics are weak, which cannot truly satisfy the requirements of professional study and job practice. The rapid development of AIGC technology brings new significant opportunities for the reform of mathematics course teaching, which is conducive to realizing the intelligentization and precision of the teaching process. The OBE concept emphasizes "student-centered, outcome-oriented, and continuous improvement" [1], so it is very suitable for backward designing of teaching objectives, teaching content, and evaluation systems. Integrating the OBE concept into the entire process of mathematics course teaching and constructing a blended online and offline teaching model allows mathematics teaching to truly shift from "knowledge transmission" to "ability cultivation," and facilitates the natural integration of mathematics courses with professional courses, which is the inevitable direction of current mathematics teaching reform.

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2 Problems in Traditional Mathematics Teaching in Applied Undergraduate Colleges

2.1 Outdated Teaching Concepts, Emphasizing Theory Over Application

Most mathematics teaching still follows the traditional teaching model, focusing on theoretical derivation and formula calculation, while neglecting practical application and professional connection. Students with a weak foundation find it difficult to understand its value, are easily prone to learning aversion, and have low learning motivation.

2.2 Single Teaching Methods, Lacking Personalization and Interaction

Traditional classrooms are mainly characterized by one-way lecturing, making it difficult for teachers to meet differentiated needs, leading to polarization and low teaching efficiency. Moreover, the channels for after-class Q&A are limited, greatly reducing learning effectiveness.

2.3 Disconnect Between Teaching Content and Professional Requirements

Different majors have different focuses on the demand for mathematical knowledge, and traditional textbooks lack examples with professional characteristics. As a result, students cannot apply mathematical knowledge to their professional studies, making it difficult to exert the instrumental role of mathematics courses.

2.4 Single Assessment Methods Unable to Measure Application Ability

Traditional assessments often adopt the "usual performance and final exam" model, which cannot evaluate students' mathematical application ability, problem-solving skills, and innovative thinking. This assessment model is contrary to the OBE concept and cannot guide students to focus on mathematical application.

2.5 Insufficient Application of Intelligent Teaching

The application of intelligent technologies such as AIGC is insufficient, and the hybrid teaching conducted is limited to a simple "online-offline" overlay, without achieving fundamental innovation in the teaching model, nor can it meet the precise teaching requirements under the OBE concept.

3 The Integration of AIGC, OBE Concept, and Mathematics Curriculum Reform

Since applied undergraduate mathematics courses do not engage in deep theoretical derivations, their basic positioning is very clear. First, it provides effective mathematical support for professional course learning. Second, it cultivates students' logical thinking, computational skills, and problem-solving abilities. Third, it is close to professional practice, downplays pure theoretical proofs, and emphasizes the use of mathematical knowledge in professional applications.

3.1 OBE: Outcome-Based Education

OBE is an educational concept systematically and rigorously proposed by American scholar Spady. It takes student learning outcomes as both the starting point and the destination, and therefore naturally designs the teaching process backward and continuously improves it. It emphasizes"student-centered, results-oriented",[5] and is thus highly compatible with the training goals of application-oriented undergraduate talents.

3.2 AIGC: Artificial Intelligence Generated Content

AIGC can provide intelligent Q&A, develop personalized learning plans, generate teaching content, conduct learning situation analysis, automatically grade homework, visualize teaching content, and accurately strengthen students' weak areas.

3.3 The Integration of AIGC, OBE Concepts, and Mathematics Teaching

The OBE concept provides guidance for mathematics curriculum reform in the context of AIGC, while AIGC technology provides technical support for the implementation of the OBE concept; the two complement and adapt to each other. First, the OBE concept clarifies the "learning outcomes students should achieve," that is, starting from the abilities that students should possess upon graduation, it emphasizes the realization of integrated knowledge, comprehensive abilities, and high-end qualities in students, setting clear goals for the application of AIGC technology and preventing intelligent teaching from becoming perfunctory. Second, AIGC technology addresses personalized teaching, precise learning analysis, and diversified assessment, making layered instruction and real-time feedback possible. Third, the integration of the two achieves blended teaching for mathematics courses both online and offline. Online, AIGC is used for autonomous learning of knowledge points and personalized tutoring, while offline, practical application and professional integration are conducted, ultimately truly achieving the teaching reform goal of outcome-oriented, technology-supported, and application-centered.

4 Reform of Mathematics Teaching Based on the OBE Concept under the Background of AIGC

4.1 Based on the OBE Concept, Backward Design of Teaching Objectives and Content

4.1.1 Clarify Hierarchical Teaching Objectives.

According to the "backward design" principle advocated in the OBE concept, [2] combining the professional talent training program and job requirements, the goals of mathematics teaching are divided into three levels: knowledge goals, ability goals, and literacy goals. The knowledge goals de-emphasize complex theoretical proofs and clearly require students to master basic concepts, formulas, and calculation rules, thereby strengthening the foundation of mathematics; The ability goals aim to cultivate students' abilities to use mathematical knowledge to solve professional problems, engage in logical reasoning, and perform mathematical calculations;The literacy goals are intended to cultivate students' rigorous academic attitude, autonomous learning ability, and innovative spirit. More importantly, different majors have different differentiated goals.

4.1.2 Reconstruct Teaching Content.

Breaking the traditional theoretical system of textbooks, removing redundant theoretical derivations and purely mathematical proofs, highlighting the application of mathematical knowledge in professional fields, and forming a modular teaching system of "foundation module, professional module, application module." The foundation module teaches the basic knowledge required for all majors; the professional module customizes content according to different majors, with the computer science major focusing on mathematical logic and programming matrix applications, and the economics and management major introducing various economic analyses such as marginal and elasticity; the application module combines AIGC technology and incorporates practical content in mathematical modeling, numerical computation, and data processing.

4.2 Relying on AIGC Technology to Build a Blended Online and Offline Teaching Model

Blended online and offline teaching is the core of this reform. By leveraging the Zhihuishu and Chaoxing intelligent teaching platforms, online courses are developed, dividing the teaching process into three stages: preview before class, teaching during class, and consolidation after class. This enables a blended teaching model with personalized online teaching, precise offline teaching, and diversified teaching evaluation[6]. It is clearly defined that students are the main participants in these three stages, balancing personalized learning with classroom interaction, and adapting to OBE outcome-oriented requirements[4].

4.2.1 Before Class: AIGC Empowers Personalized Preview, Consolidates Foundation.

With the help of the AIGC intelligent teaching platform, teachers can upload preview courseware, micro-lessons, exercises, and other resources, while the platform can automatically identify students with different levels of foundation from their learning data, thus being able to push hierarchical and differentiated preview tasks to them. Students with weaker foundations work on concept explanations and basic calculation problems, while those with stronger foundations work on application-type problems. After students complete the preview tests, AI instantly and automatically grades them, analyzes weak points, and generates learning reports to provide feedback to teachers, thereby guiding teachers to adjust teaching focus and optimize the lesson preparation process. Students can also use the AI teaching assistant at any time to answer difficulties encountered during the preview.

4.2.2 During Class: Offline Interactive Teaching, Focusing on Application and Professional Integration.

The class primarily uses offline teaching, completely abandoning traditional rote instruction and adopting a model of "case-driven, problem-oriented, group discussion". Teachers use animation software and visual teaching resources to make abstract mathematical knowledge intuitive[3], and then introduce course content through professional cases. For example, when explaining the application of derivatives, engineering majors might use "optimal path design" as an example, while economics and management majors might use "minimization of enterprise costs," naturally leading to the connection between mathematics and professional fields. By assigning group collaboration tasks, students apply mathematical knowledge to solve simple professional problems, while teachers provide timely guidance and centrally explain common issues. Before the end of the class, a short quiz is conducted, and the AIGC system instantly compiles the results, allowing teachers to give immediate feedback, ensuring knowledge is reinforced during the class.

4.2.3 After Class: AIGC Supports Personalized Consolidation, Strengthens Application Ability.

After class, using the AIGC platform, implement layered homework design and personalized tutoring, that is, automatically and promptly push differentiated assignments based on students' classroom performance. Weak students work on basic knowledge consolidation assignments, regular students work on application problems combining professional subjects and mathematics, and outstanding students work on extension assignments. At the same time, the platform automatically grades objective questions and provides standardized and clear solution ideas for subjective questions, greatly reducing the teachers' workload. Students can use the AI teaching assistant to systematically review incorrect questions and independently consolidate knowledge points, and the platform automatically generates personalized learning reports. Teachers assign practical tasks integrated with professional subjects, truly imple-

menting OBE results-oriented teaching, allowing mathematics and professional courses to naturally integrate.

4.3 Deepen the Integration of Mathematics and Major Courses

The reform of the mathematics curriculum breaks down the barriers between mathematics and professional courses, establishing a collaborative teaching mechanism of "mathematics teachers and professional teachers." First, mathematics teachers and professional teachers discuss together to sort out the required mathematical knowledge points, clarify the teaching focus, and integrate professional cases into mathematics classes. Then, professional practice sessions are set up within mathematics courses, with professional teachers assisting in guidance, allowing students to learn to use mathematical tools to solve real professional problems. For example, computer science majors apply linear algebra to algorithm optimization, and economics and management majors use calculus for market demand analysis, enhancing students' learning motivation.

4.4 Build a Diversified Assessment and Evaluation System Oriented by OBE

Starting from the OBE approach, we construct a diversified evaluation system of "process-oriented, terminal, and applied ability", thereby providing a full and objective assessment of students' acquired knowledge, applied skills, and overall competence: Process-oriented assessment accounts for 40%, including online preview, classroom interaction, exercises on the AIGC platform, group assignments, and attendance, to track the learning process comprehensively. Terminal assessment accounts for 30%, primarily based on the final exam, with selected questions focusing on basic calculations and professional application problems, while appropriately downplaying theoretical proofs. Applied ability assessment accounts for 30%, using mathematical modeling, interdisciplinary practice reports, and group projects as mediums to evaluate mathematical application skills.

4.5 Strengthen Teachers' Information-Based Teaching Ability and Build a Dual-Qualified Teaching Team

By organizing training for mathematics teachers in AIGC technology applications, OBE concepts, and blended teaching, their ability in intelligent teaching and curriculum design is improved. At the same time, mathematics teachers are encouraged to engage with the profession, understand the talent cultivation requirements and curriculum system of the field, thereby building a dual-qualified teaching team proficient in both mathematics teaching and professional application. At the same time, an exchange platform is established, jointly developing teaching cases that integrate mathematics into professional practice.

5 Conclusion

By constructing an "AIGC OBE" blended teaching model adapted for application-oriented undergraduate programs, the teaching transformation of "student-centered, competence-based" has been achieved, comprehensively and objectively reflecting students' learning outcomes, in line with the OBE educational concept. AIGC technology provides technical support for the reform of mathematics courses, and the OBE concept guides the direction of teaching reform. The online-offline blended teaching model built from the integration of the two effectively addresses the pain points of traditional mathematics teaching, realizing the transformation of mathematics course instruction from "knowledge transmission" to "ability cultivation," strengthening the support of mathematics courses for professional talent training, and improving the quality of course teaching.

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